REMARKS

In the Office Action, the Examiner rejected Claims 1-20, which are all of the pending claims, under 35 U.S.C. 103 as being unpatentable over the prior art. Claims 1, 3, 11 and 18 were further rejected under 35 U.S.C. 112, first, paragraph, as failing to comply with the written description requirement.

More specifically, Claims 1, 2 and 18-20 were rejected under 35 U.S.C. 103 as being unpatentable over U.S. Patent 5,513,029 (Roberts) in view of U.S. Patent 6,208,441 (Jones, et al.) and further in view of U.S. Patent 5,777,773 (Epworth, et al). Claims 3, 7-11 and 15-17 were rejected as being unpatentable over Roberts in view of Epworth; and Claims 4-6 and 12-14 were rejected as being unpatentable over Roberts in view of Epworth, et al. and Jones, et al.

Independent Claims 1, 3, 11 and 18 are being amended to better define the subject matters of these claims. Also, Claim 2 is being amended to improve the form of the claim, and Claim 10 is being amended to describe a preferred feature of the invention.

For the reasons set forth below, Claims 1, 3, 11 and 18 fully comply with the requirements of 35 U.S.C. 112, and Claims 1-20 patentably distinguish over the prior art. The Examiner is, thus, respectfully requested to reconsider and to withdraw the rejection of Claims 1, 3, 4 and 18 under 35 U.S.C. 112 and the rejections of Claims 1-20 under 35 U.S.C. 103, and to allow Claims 1-20.

The present invention relates to optical networks that carry multiple optical signals at multiple wavelengths. As discussed in detail in the present application, optical networks encode information to be transmitted and received, and a stable optical power level is vital to set and maintain the threshold of the code for digital data. Various schemes have been proposed to achieve this stable optical power level. However, these schemes are often inaccurate and can be expensive to implement in networks that carry many wavelengths with dense wavelength spacing.

The present invention is able to achieve this stable optical power level through the unique use of an optical filter. More specifically, in accordance with this invention, the multiple wavelengths, each in an associated channel, in the network are dithered about the central wavelengths of the channels, and directed through the optical filter to obtain a measurement of the optical transfer function in the network at any instant in real time. In this way, any changes in the optical transfer function can be tracked, and feedback signals are used to compensate for those changes.

The filter, in effect, functions as part of a very inexpensive real time optical spectrum analyzer. This, in turn, allows for very fast response corrections and enables the use of networks with more wavelengths spaced more closely together.

In rejecting Claims 1, 3, 11 and 18 under 35 U.S.C. 112, the Examiner argued that the specification does not disclose adjusting wavelengths of optical signals transmitted through a dithered optical bandpass filter.

To overcome the Examiner's objection, Claims 1, 3, 11 and 18 are being amended to remove the description of dithering the filter bandpass, and instead to describe the feature that the wavelengths of the optical signals or channels are dithered. Procedures for dithering wavelengths are discussed in the specification from page 6, line 30 to page 7, line 4 and from page 8, line 34 to page 10, line 10. These portions of the specification provide the written description for the language used in the claims.

In view of the above-discussed changes to Claims 1, 3, 11 and 18, the specification provides the appropriate written description, within the meaning of 35 U.S.C. 112, of the subject matter of these Claims. The Examiner is, accordingly, asked to reconsider and to withdraw the rejection of Claims 1, 3, 11 and 18 under 35 U.S.C. 112.

With respect to the rejection of the claims under 35 U.S.C. 103, the examiner rejects as obvious claims 1, 2, and 18-20 over Roberts in view of Jones and Epworth. The examiner contends that Roberts in combination with Jones teaches the use of dither feedback using add/drop filters. This is an oversimplification; there are a number of important features of the preferred embodiment of the present invention that are not shown in or suggested by this combination of references.

For example, one key feature of this preferred embodiment of the invention which is not disclosed by Roberts, Jones, or a combination thereof is that the present invention calculates the vector inner product of the filtered, dithered optical signal with the original dither reference. This calculation is not performed by Roberts or Jones (or for that matter, Epworth); in fact, referencing Roberts figure 2, shows that Roberts does not provide any connection between the dither modulation signal and any other point in his apparatus.

Further, the preferred embodiment of this invention provides a frequency doubles signal when the filter and laser are locked; this is not provided by Roberts, Jones, or Epworth.

Roberts encodes the optical dither with a pseudorandom signal, while the instant invention requires only a periodic, sinusoidal modulation. In fact, Roberts is controlling the optical POWER, NOT WAVELENGTH, of laser sources by direct modulation of the drive current. The present invention adjusts laser wavelength with respect to the peak of a passband filter. Thus, Roberts does not actually perform wavelength locking at all with his approach.

Moreover, Roberts requires a number of features not required by the present invention, including indirect estimation of signal/noise components for each wavelength, gain compensation, and use of microcontrollers to measure various aspects of his encoded dither signal.

The Examiner contends that Epworth discloses dithering a bandpass filter for locking the bandpass signal, citing col. 1 lines 21-38. This is incorrect. Lines 21-38 of Epworth state that in

principle dither may be applied to an optical component such as a passive frequency reference or chromatic dispersion compensator to vary its response with respect to frequency, or equivalently dither may be applied to the laser source. This citation does not disclose dithering the frequency response of a bandpass filter about the center of its passband. In fact, nowhere in Epworth is there a depiction of a dither modulation signal applied to a bandpass filter; the only signals applied to bandpass filters, either in the prior art figures or in Epworth figure 8 and 9, are control signals which tune the filter bandpass, and which are driven to zero when the filter is locked. Clearly these control signals, which are intended to be driven to zero during locked operation, are not dither modulation signals. Again, there is no discussion of dithering a bandpass filter in Epworth...thus, the examiner's contention that Epworth combined with Roberts and Jones discloses this feature is incorrect.

The Examiner objects to claim 2 citing a combination of Roberts, Jones, and Epworth disclosing a wavelength locked feedback loop allowing spectral decomposition (citing Roberts col. 11 line 1 to col. 12 line 40). In fact, Roberts does not disclose wavelength locking, but rather a feedback loop to control the power, not wavelength, of a laser source. Jones also does not mention wavelength control or locking. Epworth does mention frequency control of a laser source, however he does not teach frequency doubling of the error signal as in our invention (none of the cited prior art does). The cited reference for Roberts describes how an ENCODED dither signal may be deciphered to recover certain aspects of the signal spectrum using a digital microcontroller. The present invention uses an UN-ENCODED dither signal and does not require a microcontroller, yet it achieves wavelength locking. This is a significant difference from the prior art.

The Examiner objects to claim 18, again saying that Roberts discloses the means for dithering the wavelength of a laser channel. This is incorrect; Roberts teaches a WDM system in which each laser transmitter (operating at a different wavelength) is dithered at a low frequency; later, the signals are tapped so that total power and signal-to-noise measurements can be taken for each wavelength (col. 4 lines 5-20). Roberts dithers the <u>amplitude</u> of each signal, not the <u>wavelength</u>. Roberts is concerned with measuring performance of an optical transmission system, to make signal power measurements (col. 3 lines 4-14). Roberts does not have wavelength or frequency control of either the laser or filter as an object or an outcome of his invention. Thus, objections based on the assertion that Roberts teaches wavelength dithering are incorrect.

Similar responses apply to the Examiner's objections to claims 19 and 20, which depend on the apparatus of claim 18 as being obvious in view of a combination of Roberts with Jones and Epworth.

The Examiner also objects to claims 3, 7-11, and 15-17 as unpatentable over Roberts in view of Epworth. The Examiner once again states that Roberts discloses dithering the wavelengths of signals in a WDM network, when in fact this is not the case (see Roberts col. 4 lines 5-20). The confusion arises when Roberts states that each wavelength in a WDM system is produced by a different laser, and that each laser is modulated with a unique encoded low frequency dither signal; in this way, the different dither signals can be used to distinguish one wavelength from another.

Roberts refers to this as "dither signals...encode the wavelengths of the optical transmitters" and states in the cited text that "dither signals which encode distinct transmitter wavelengths ...ensure that the dither amplitudes of signals at distinct wavelengths are separately measurable". This should not be confused with the operation of the present invention, which does not dither signal amplitude (as in Roberts) but rather dithers signal wavelength. Roberts does not change the laser

wavelength; he simply encodes each wavelength with a dither signature for later identification. The instant invention changes the laser wavelength, not the laser amplitude. Thus, objections based on Roberts anticipating wavelength dithering are unfounded.

Similar arguments can be used in response to the Examiner's objections to claims 7 through 11 and claims 15 through 17 based on combinations of Roberts with Epworth, Jones, or both. A fundamental different of the present invention from all of this prior art is the use of wavelength dithering, which arise not disclosed elsewhere.

The Examiner objects to claims 4-6 and 12-14 as unpatentable over Roberts in view of Epworth and further in view of Jones. It is important to note that this invention, in its preferred embodiment, equalizes signals by adjusting their wavelengths with respect to the centerpoint of a bandpass filter; while the prior art directly adjusts the laser power through controlling the drive current. Thus although the present invention achieves a similar effect, the mechanism by which the present invention achieves this is quite different; neither Roberts, Epworth, or Jones teaches wavelength control via dithered feedback.

On pages 13 and 14 of the Office Action, the Examiner notes that Roberts does not disclose dithering the bandpass filter function, but that Epworth does teach this as applicable in the combination (the Examiner does not cite specific text in Epworth for this). Examiner also notes that Applicants have not cite specific deficiencies of Epworth in combination with Roberts. The Examiner may be referring to figure 9 in Epworth, which is the only figure showing a tunable filter with means to control the frequency response (figure 8 shows a more generic version with a "tunable component" identified, the text indicates that figure 9 represents an embodiment of figure 8).

In these figures and associated text (Epworth lines 9-35), it is described how the phase shifted original dither signal is applied to a phase sensitive comparator, along with the filtered output of the tunable filter; the intent is to drive the error signal output from the phase sensitive comparator to zero when the laser and filter are locked to each other.

In this connection, Applicants would like to note the following points:

1) Epworth does teach adjusting the bandpass of a tunable filter, however he does NOT teach dithering the filter bandpass. There is no dither signal applied to the bandpass filter in Epworth; the only signal applied to the bandpass filter is to adjust its bandpass in response to an error signal, said adjustment stops when the error signal goes to zero, at which point the laser and filter are locked to each other. Since Epworth does not teach dithering the filter bandpass, and as previously noted Roberts also does not teach it, then the combination of Epworth and Roberts does not teach dithering the filter bandpass.

2) Epworth does not teach several other features including the generation of a frequency doubled signature when the laser and filter are locked together. Epworth also does not teach the generation of partial frequency locking conditions as the laser/filter combination approaches lock, as in the present invention. Note that one advantage of the preferred embodiment of this invention over Epworth is that the system of this invention does not rely on a signal approaching zero in order to achieve lock; this is difficult in practice, since electrical noise will make it difficult to determine exactly when the signal reaches zero and will place a fundamental limit on the accuracy of Epworth's error signal.

Independent Claims 1, 3, 11 and 18 describe important features that are not shown or suggested by the prior art. In particular, Claim 1 describes the feature of dithering the center wavelength of each channel in use in the network and passing each channel with the dithering center wavelength through the optical filter bandpass to obtain a measurement of the optical transfer function (OTF) in the network at any instant in real time. In this way, as further described in Claim 1, when the OTF of the network is changed, that change is tracked and feedback signals are used to compensate for the change.

Claim 3 describes the step of tracking changes to the set of optical signals by dithering the center wavelengths of each of said set of signals, and passing each of the signals with dithering center wavelengths through a filter having a bandpass function to generate filter output signals. Claim 3 describes the further step of using those filter output signals to compensate for those changes. Claims 11 and 18, analogously, both describe means for dithering the wavelengths of the optical signals relative to the filter bandpass, and to pass the set of optical signals through the filter, to generate filter output signals, and a control for using those output signals to compensate for changes to the optical signals.

Because of the above-discussed differences between Claims 1, 3, 11 and 18 and the prior art, and because of the advantages associated with these differences, Claims 1, 3, 11 and 18 patentably distinguish over the prior art and are allowable. Claim 2 is dependent from Claim 1 and is allowable therewith; and Claims 4-10 are dependent from, and are allowable with, Claim 3. Likewise, Claims 12-17 are dependent from, and are allowable with, Claim 11; and Claims 19 and 20 are dependent from Claim 18 and are allowable therewith. The Examiner is, accordingly, asked to reconsider and to withdraw the rejections of Claims 1-20 under 35 U.S.C. 103, and to allow these claims.

For the reasons set forth above, the Examiner is asked to reconsider and to withdraw the rejection of Claims 1, 3, 11 and 18 under 35 U.S.C. 112 and the rejections of Claims 1-20 under 35 U.S.C. 103, and to allow these claims. If the Examiner believes that a telephone conference with Applicants' Attorneys would be advantageous to the disposition of this case, the Examiner is requested to telephone the undersigned.

Respectfully submitted,

John S. Sensny
John S. Sensny
Registration No. 28,757
Attorney for Applicants

SCULLY, SCOTT, MURPHY & PRESSER, P.C.
400 Garden City Plaza – Suite 300
Garden City, New York 11530
(516) 742-4343

JSS:jy